

# West-Central Florida Coastal Transect # 4: Indian Rocks Beach

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## Introduction

A major goal of the West-Central Florida Coastal Studies Project was to investigate linkages between the barrier-island system along the west coast of Florida and offshore sedimentary sequences. High population density along this coastline and the resultant coastal-management concerns were primary factors driving the approach of this regional study. Key objectives were to better understand sedimentary processes and sediment accumulation patterns of the modern coastal system, the history of coastal evolution during sea-level rise, and resource assessment for future planning. A series of nine "swath" transects, extending from the mainland out to a depth of 26 m, was defined to serve as a focus to merge the data sets and for comparison of different coastal settings within the study area.

Transect #4 extends seaward from the Indian Rocks Beach headland (see location map to right). Information from seismic and vibrocore data is combined to derive a 2-D stratigraphic cross section extending from the offshore zone, through the barrier island, and onto the mainland. This stratigraphic record represents the late Holocene evolution of the coastal-barrier system and inner shelf following the last sea-level transgression and present highstand conditions. A comparison to surface-sediment distribution patterns indicated by side-scan sonar imagery and bottom grab samples illustrates the importance of spatial variability in sediment-distribution patterns offshore when considering stratigraphic interpretations of seismic and core data.

## Methods

The primary data sets used in this study were collected from 1993 to 1998. Geophysical surveys included high-resolution single-channel "boomer" seismic data and 100-kHz side-scan sonar imagery (Locker and others, 2001). Most of the reconnaissance seismic and side-scan sonar data were acquired during two offshore cruises in 1994. Additionally, bottom samples were collected during the cruises using an underway grab sampler at 4-km intervals along track. Offshore core locations were selected based upon seismic data and were focused in areas likely to contain sufficient sediment thickness for core retrieval (Brooks and others, 1999). Vibrocores and probe data provided stratigraphic control in the barrier-island and bay areas.

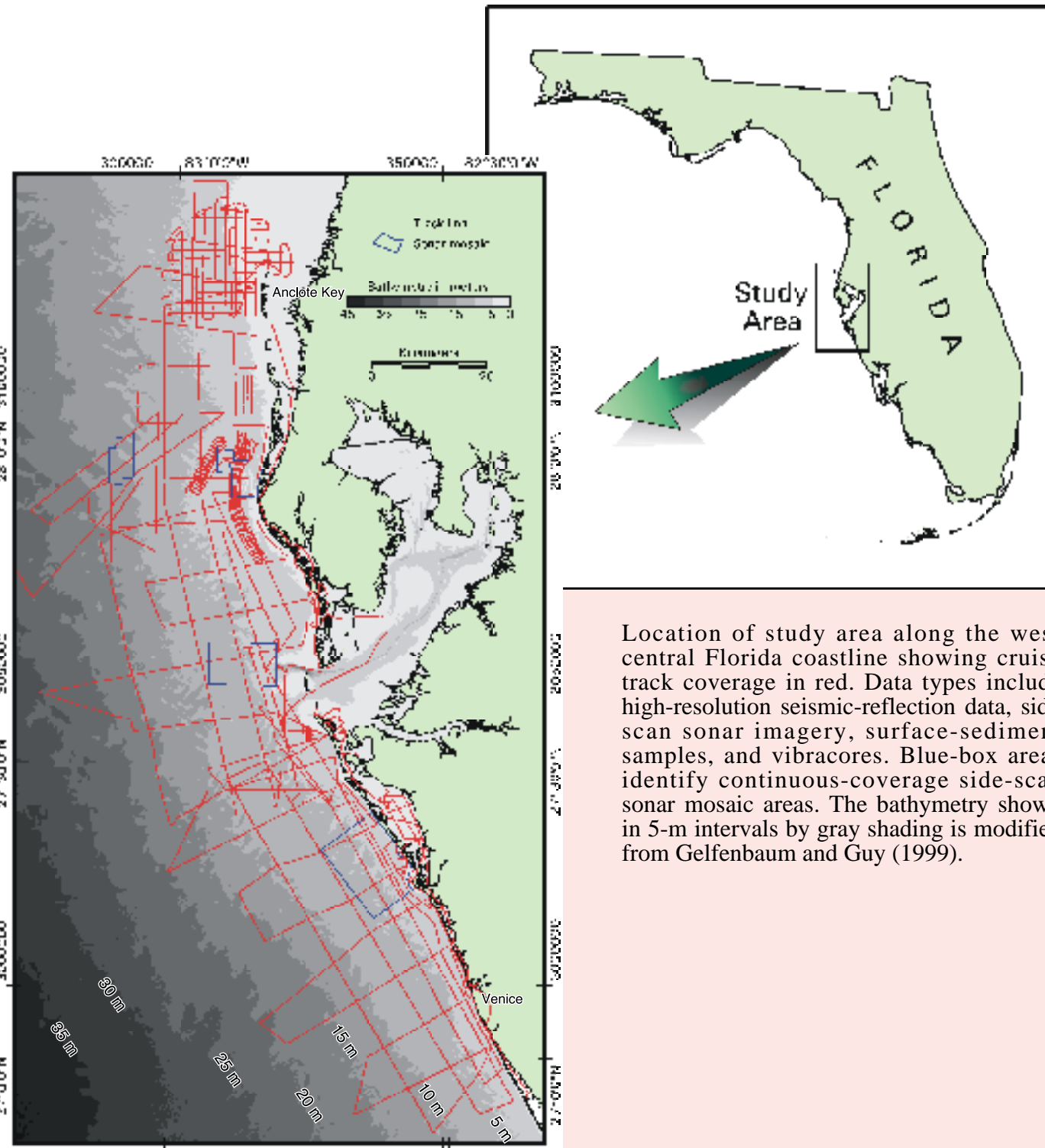
The four panels showing location and side-scan sonar imagery, seismic data, and a stratigraphic cross section are at the same horizontal scale. The seismic profile and cross-section panels are constructed by fitting the data between the labeled cross-section turns (location map panels) that have been projected downward to the straight cross-section line. Subtle differences in the horizontal scale of segments in the cross section due to this projection are minimal. The horizontal scale, as well as vertical exaggeration of the seismic profile and cross section, are the same for all nine transects in the map series in order to facilitate comparison among transects.

## Geologic History and Morphodynamics of Barrier Islands

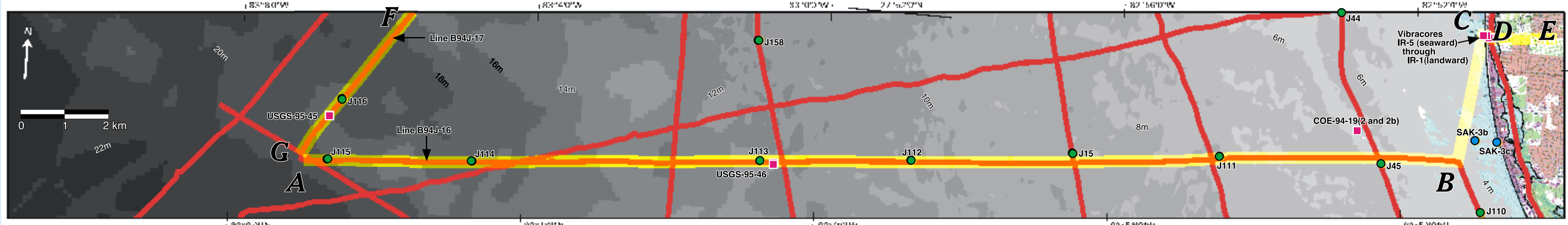
Barrier islands on the west-central Gulf coast of Florida display a wide range in morphology along the most diverse barrier/inlet coast in the world (Davis, 1994). In addition, the barriers have formed over a wide range of time scales from decades to millennia. The oldest of the barriers have been dated at 3,000 years (Stapor and others, 1988) and others have formed during the past two decades. The barrier system includes long, wave-dominated examples as well as drumstick barriers that are characteristic of mixed wave and tidal energy. Historical data on the very young barriers and stratigraphic data from coring older ones indicate that the barriers formed as the result of a gentle wave climate transporting sediment to shallow water and shoaling upward to intertidal and eventually supratidal conditions. The barriers probably formed close to their present position and several have been aided in their location and development by antecedent topography produced by the shallow Miocene limestone bedrock (Evans and others, 1985). The two most important variables that control barrier-island development along the coast are the availability of sediment and the interaction of wave and tidal energy.

## Indian Rocks Beach

The area of Sand Key at the Indian Rocks location is the narrowest portion of the barrier-island system in the entire study area. The back-barrier environment is only about 200 m wide and the barrier itself is about 100 m wide. The Indian Rocks headland is dominated by the presence of Miocene limestone at sea level along the landward shoreline. The bedrock surface dips steeply in the gulfward direction as shown by the stratigraphic section along the transect (Yale, 1997). The organic muddy sand of the vegetated paralic environment is absent over most of the transect, probably as the result of relatively high-energy wave climate in the headland area which removed it. The barrier displays a typical wave-dominated character with apparent back-barrier muddy shelly sand beneath the facies of the barrier island itself. The barrier consists of beach, dune, and supratidal washover deposits. Although the age of formation of Sand Key is unknown, a piece of detrital wood taken from 1.5 m below the surface of the island was dated at 1,150 (YBP).



Location of study area along the west-central Florida coastline showing cruise track coverage in red. Data types include high-resolution seismic-reflection data, side-scan sonar imagery, surface-sediment samples, and vibrocores. Blue-box areas identify continuous-coverage side-scan sonar mosaic areas. The bathymetry shown in 5-m intervals by gray shading is modified from Gelfenbaum and Guy (1999).

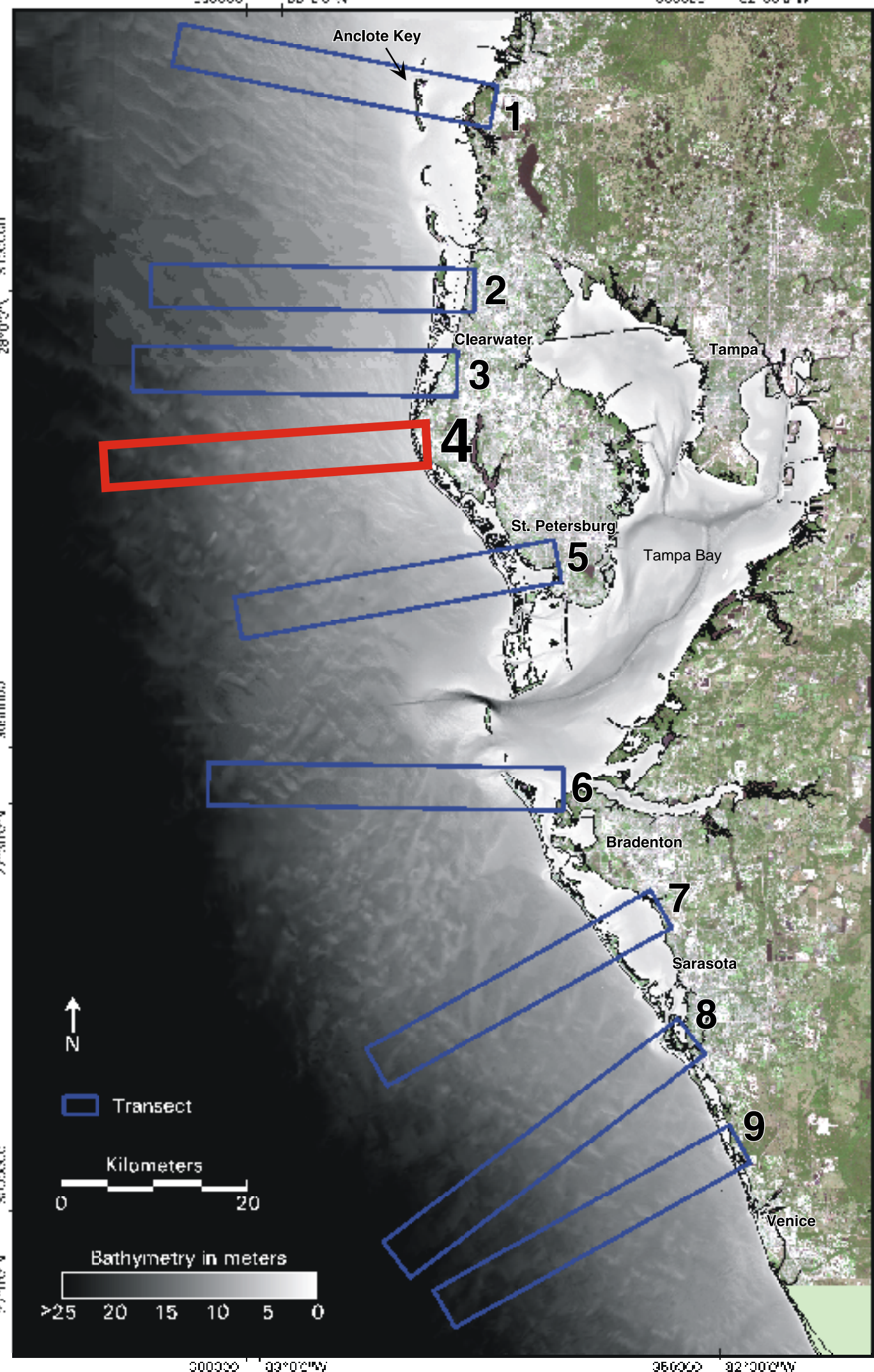


## Location map

Map showing bathymetry, cruise-track coverage, core and bottom sample locations, and location of figures. This site is the most prominent headland within the west-central Florida study area. The full transect cross section A-E is presented below. An expanded view of the island portion of the transect C-D is shown at lower right. Line F-G locates the seismic profile shown at lower left.

## Side-scan sonar data

Side-scan sonar imagery overlain on bathymetry reveals a northwest-trending sand-ridge morphology common throughout the inner shelf in this region. Surface-sediment cover is thin and exhibits a patchy and discontinuous distribution. Low backscatter (light gray) areas correspond to sand ridges and flats dominated by quartz sand. The dark (high backscatter) areas are largely coarse sediment veneer with increased carbonate material (primarily shell debris), or some hardbottoms. Data from a series of six closely spaced side-scan swaths in the nearshore are available only as interpretations of sonar imagery depicting two shades of gray (from Gelfenbaum and others, 1995).



## Surface sediments

Grain-size and composition data for bottom grab samples are presented below the sonar imagery. Samples generally consist of quartz-rich sand with subordinate amounts of gravel and mud. Many samples are rich in carbonate gravel or sand. Low backscatter correlates with medium to fine siliciclastic sand with few carbonate grains. The higher backscatter areas correlate with coarse grain size and increased carbonate. The coarse-grained facies is thin and typically exhibits ripple crests which trend N-S with a 40- to 70-cm spacing.

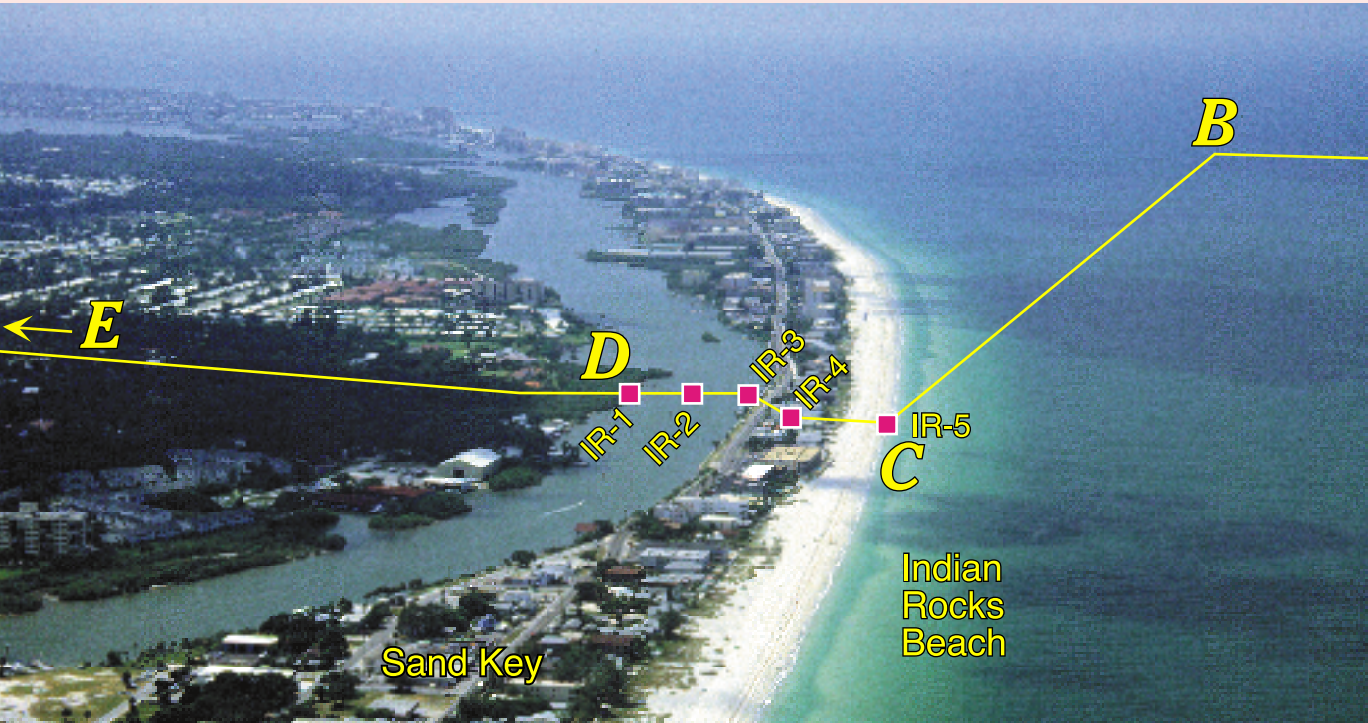
## Seismic-profile data

Uninterpreted seismic profile illustrates the poor acoustic contrast between the Holocene sediment cover and the Pleistocene exposure surface. The poor contrast is typical throughout the region and is attributed to the karst and weathered nature of the underlying pre-Quaternary bedrock. Overall, the base of the Holocene is extrapolated from vibrocore data that supports the seismic interpretations. Additional evidence includes hardbottoms (pre-Holocene bedrock) and probe-rod measurements of sediment thickness. The modern sediment cover is usually less than 2 to 3 m thick, corresponding with the higher-relief portions of the sand waves or ridges seen here. In this area, the thickest sand deposits were found at the offshore end of the survey in greater than 15 m water depth.

## Transect cross section A-E

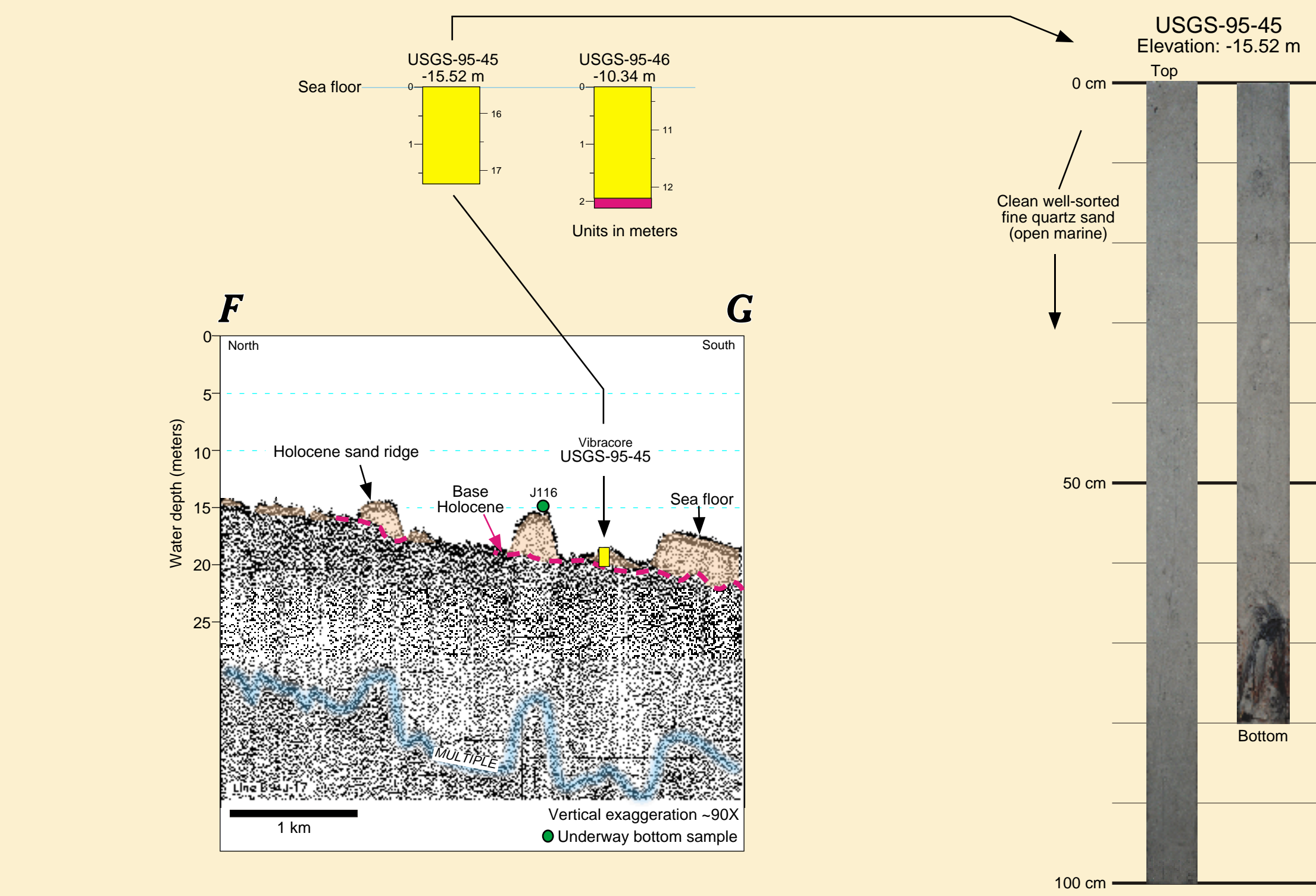
Integrated stratigraphic cross section combining line-drawn interpretation of seismic data, ground truthed by coring, with a coastal cross section based on vibrocores. Cores in the offshore transect have no cross-shelf correlation potential because they often contain different ridge deposits, shown in side-scan sonar imagery and bathymetry data. This coastal section has less sand volume than is typically found in the west-Florida transects. Positions of the coastline and barrier-island are strongly controlled by antecedent topography of the underlying Miocene limestone bedrock.

Holocene sediment



Oblique aerial photograph taken in 1997 of Sand Key (looking SE) at the Indian Rocks Beach headland. A very narrow barrier reflects the divergence of alongshore sediment transport occurring in this area. The island transect section (C-D) is shown here with vibrocore locations presented below. Miocene limestone is exposed along the mainland shoreline just north (foreground) of D.

## Offshore Cores



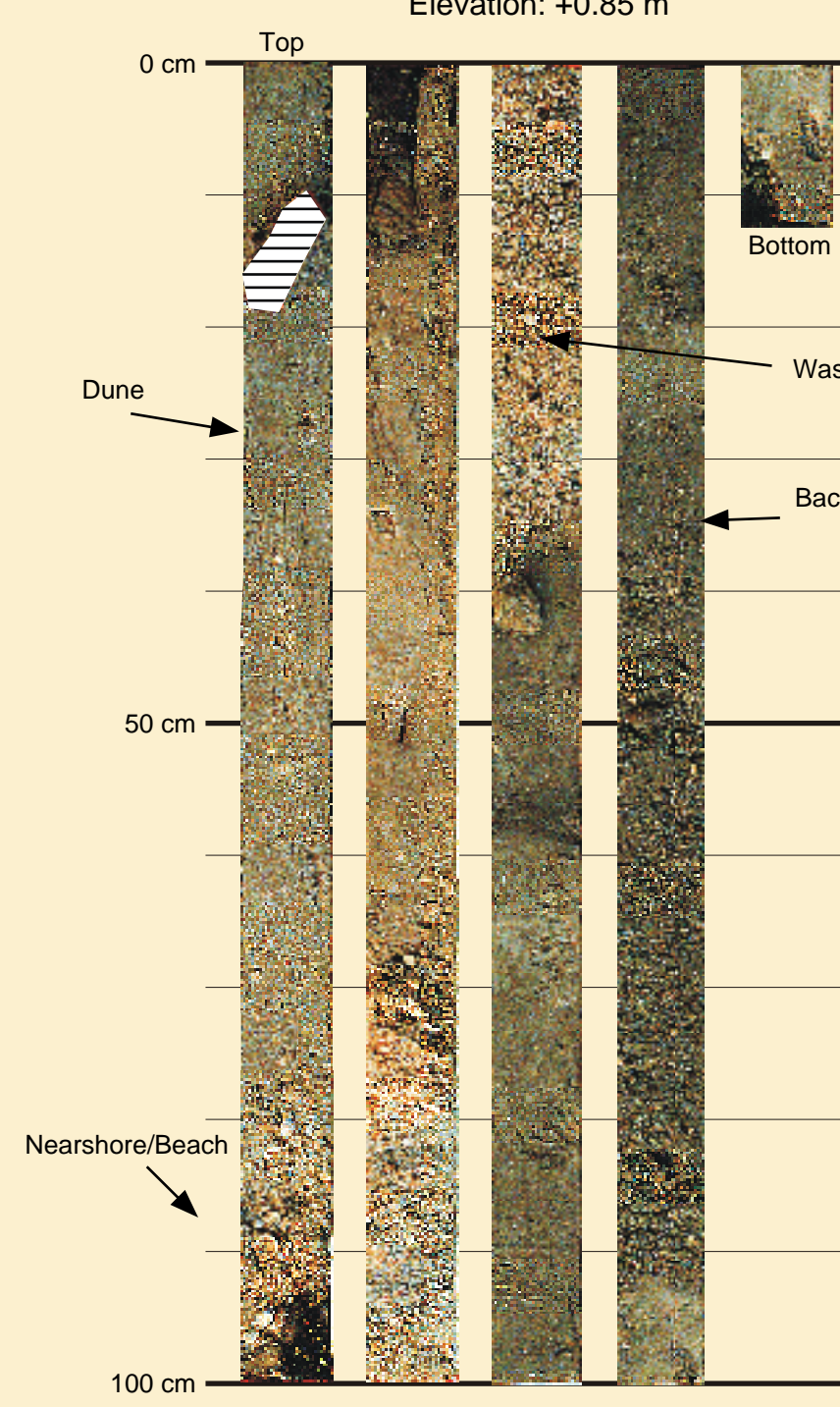
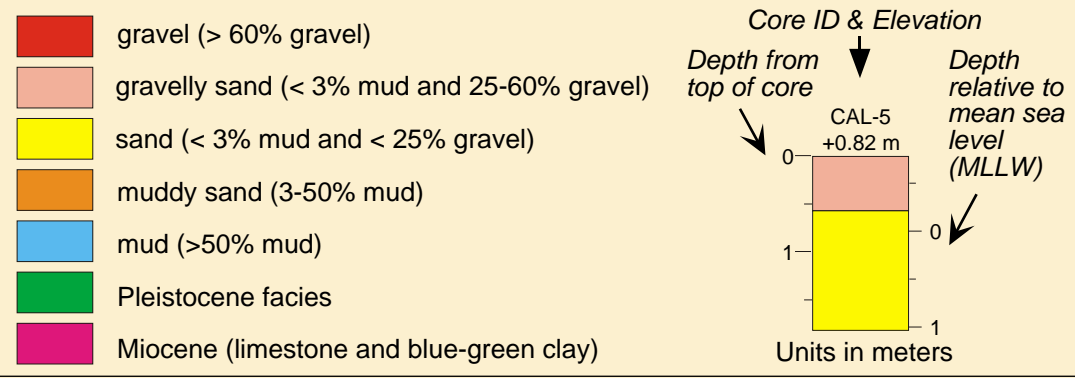
## Core Data

Seven generalized sedimentary-facies types were defined for a unified comparison of core data from the entire study area. All seven color-coded facies for the entire study are shown in the Explanation below. However, not all facies necessarily are present on each transect. Core photographs present individual cores cut into 1-m sections from top (upper left) to bottom (lower right). Discrepancies in core length between the photographs and the diagrams are due to compaction during the coring process. Offshore cores (left) are aligned at core tops. Core locations were chosen to sample thicker Holocene sections and to aid in identifying pre-Holocene stratigraphy. Core elevations were determined from water depth and tide tables. The datum for the barrier-transect cores is the mean lowest low water (MLLW). Core photographs are shown for USGS-95-45, an offshore sand ridge, and IR-4 that penetrates the barrier island.

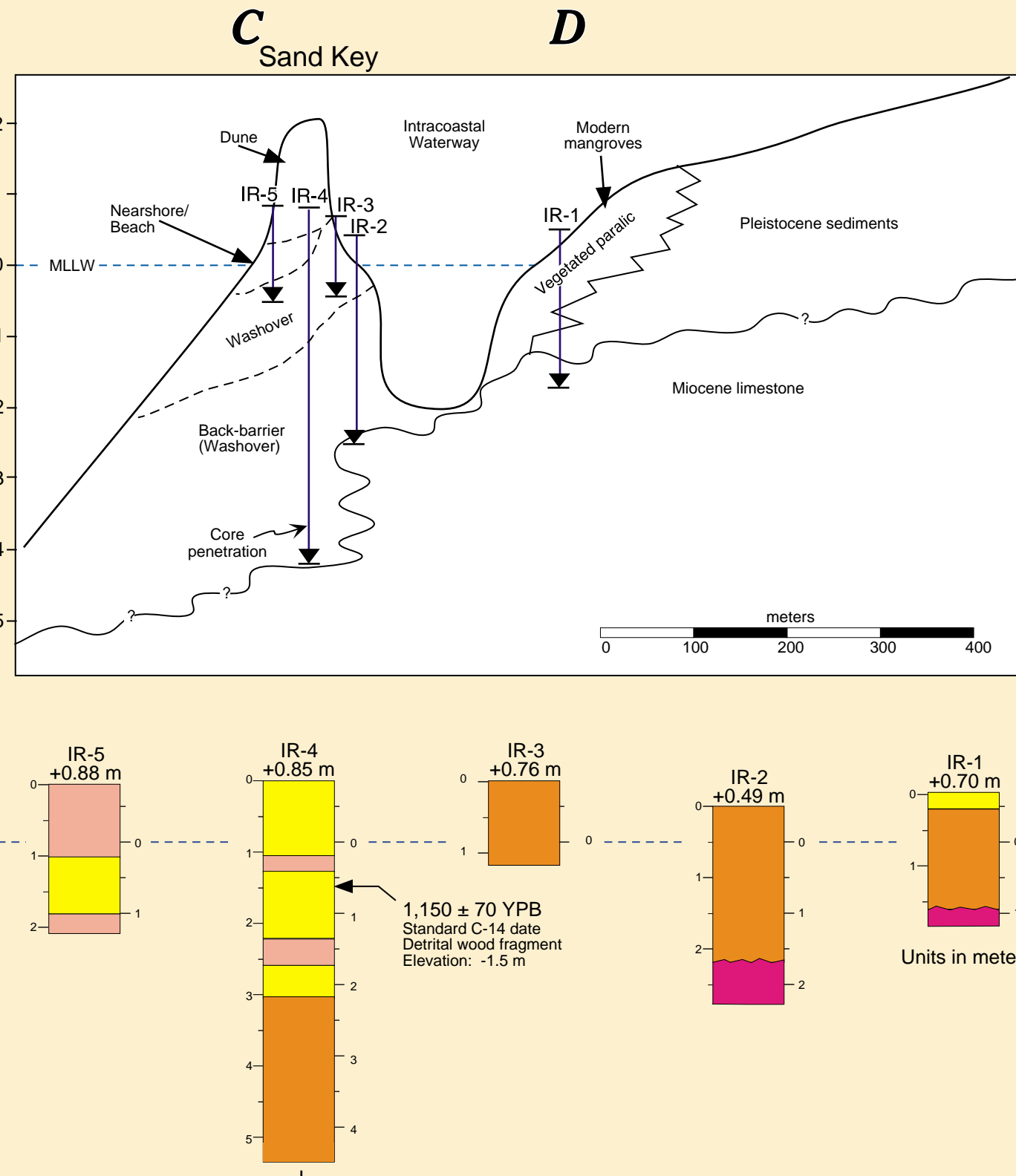
Offshore vibrocore retrieval verified that much of the area contains less than 2 m of sediment. All cores contain a surface layer dominated by quartz sand. The surface layers are interpreted to be of open-marine origin. Although the vibrocores penetrated to bedrock, there is often little indication of a bedrock reflector seen in the seismic data (see above and at left). A poor impedance contrast between well-sorted shelf sand and the underlying exposure surface appears to be responsible for the lack of a well-defined seismic boundary at the base of the Holocene section.

The expanded coastal cross section at right reveals a thin wedge of Holocene back-barrier and beach-ridge/dune deposits that have overlapped the steeply rising Miocene limestone and Pleistocene facies of the mainland. Dredging for the Intracoastal Waterway has increased the depth of the back-barrier channel. On cross sections where cores do not penetrate to bedrock, the control is based on probe-rod data.

### Explanation: core logs and sedimentary facies



## Barrier-Island Cores and Transect



## References Cited

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## Data references:

Color Infrared Digital Orthophoto Quarter Quadrangles (CIR DOQQ), (1994, 1995). USGS EROS Data Center, Sioux Falls, SD 57198, CD-ROMs.

Landsat TM Image, February 18, 1997, path 17, row 40. USGS EROS Data Center, Sioux Falls, SD 57198, CD-ROM.

7.5-Minute Series (Topographic) Quadrangles. U.S. Geological Survey, Reston, VA 22092.

## List of west-Florida coastal-transect series maps (1 sheet each):

Transect #1: Anclote Key, USGS Open-File Report 99-505  
Transect #2: Caladest Island-Clearwater Beach, USGS Open-File Report 99-506  
Transect #3: Sand Key, USGS Open-File Report 99-507  
Transect #4: Indian Rocks Beach, USGS Open-File Report 99-508  
Transect #5: Treasure Island-Long Key, USGS Open-File Report 99-509  
Transect #6: Anna Maria Island, USGS Open-File Report 99-510  
Transect #7: Longboat Key, USGS Open-File Report 99-511  
Transect #8: Siesta Key, USGS Open-File Report 99-512  
Transect #9: Casey Key, USGS Open-File Report 99-513